Fermilab Directorate

MEMORANDUM OF UNDERSTANDING
FOR THE 2004 MESON TEST BEAM PROGRAM

T941

University of Iowa PPAC Test

June 4, 2004

INTRODUCTION

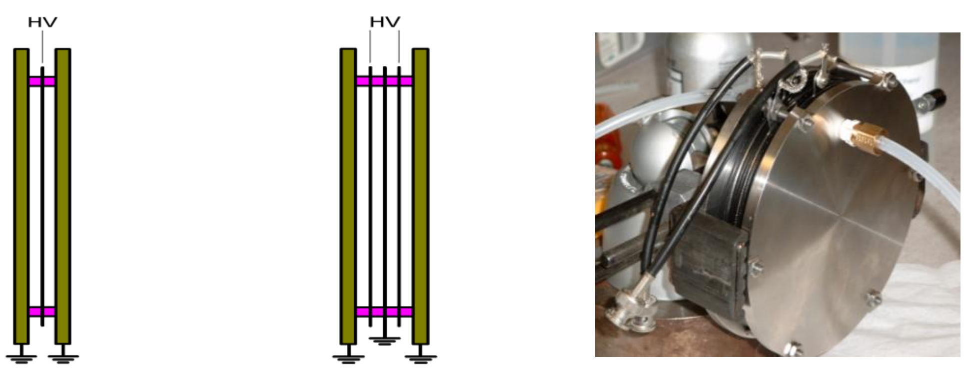
This proposal requests beam time at Fermilab during the 2004 Meson Test Run to measure the energy and time resolution of a Parallel Plate Avalanche Counter (PPAC).

Low pressure PPACs are excellent detectors for measuring ionization in a sampling calorimeter. They have been in use for a quarter of a century as detectors for low and intermediate energy heavy ions, but they have seen little use in high-energy physics. A single minimum ionizing particle will leave little or no signal in passing through a PPAC, but a TeV shower contains hundreds of charged particles and is easily measured with a PPAC. For the test, 10 inches of iron will be placed in front of the PPAC to develop the shower.

Gas detectors are generally not recommended for use with hadrons in sampling calorimeters because of the "Texas tower effect." Neutrons in the shower occasionally produce a heavily ionizing particle in the gas that makes a huge signal. Our preliminary calculations indicate that this will not be a problem with a low pressure PPAC.

A typical PPAC is two flat plates 2 mm apart with a voltage of 750 V between them and a filling gas of 20 torr of isobutane. The large voltage gradient causes each primary electron to make an avalanche with current gains of 10^4 to 10^5.

For use with heavy ions, the electrodes are made extremely thin so that the particles to be measured can get into the detector without losing a significant amount of energy. For use in calorimeters it is better to have two heavy, grounded plates to withstand atmospheric pressure with a single, thin plate at high voltage between them (a). To test the performance of the detector we made a double PPAC. It has two HV plates with a grounded plate between them (b). The actual device is shown in (c). Signals are taken from the two HV plates. A comparison of the two signals provides a measurement of the energy and time resolution of the PPAC.



(a) (b) (c)

This is a memorandum of understanding between FNAL and the U of Iowa PPAC group. This memorandum is intended solely for the purpose of providing a work allocation for FNAL and the U of Iowa. It reflects an arrangement that is currently satisfactory to the parties involved. It is recognized, however, that changing circumstances of the evolving research program will necessitate revisions. The parties agree to negotiate amendments to this memorandum to reflect such revisions.

I. PERSONNEL AND INSTITUTIONS:

Physicist in charge of beam tests: Edwin Norbeck, University of Iowa

Fermilab liaison: Erik Ramberg

The group members at present and others interested in the testbeam are:

1.1 Present at FermiLab: David Northacker

1.2 University of Iowa: E. Norbeck, J. Olson, Y. Onel

II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS

2.1 LOCATION

2.1.1 The experiment is to take place in the MTEST beam line and located in the area designated MT6-B4. In addition, the main control room to the west of the MTEST line will be used to house electronics (one NIM bin, one CAMAC, our computer, and scope), and provide a small amount of work space (for 3 people).

2.2 BEAM

2.2.1 The tests will use slow resonantly-extracted, Main Injector proton beam focused onto the MTest target. The tests require a beam of untagged, charged protons of the maximum energy available, 120 GeV.

2.1.2 Intensity: In the range of 1-10 KHz in an area of a square cm or so. With the current beam line design this is expected to require up to 2 x 10^{10} primary protons per second. It needs to be able to be steered into the middle of a 6 in diameter circle.

2.3 SETUP

We will put the setup on a machinist's table with castors. The table, and everything on it, can be set up outside of the radiation area. An hour or so will be required to move the table into the radiation area and connect the four coax cables and the two gas lines. Time will be required before this to string the cables. The table, with everything connected, will be located next to the beam line so that it will not interfere with beam going further downstream. The table will be moved in front of the beam just before the beam is expected. Moving the table in or out of the beam line should require no more than 5 minutes. The gas system (vacuum pump, controller, and gas cylinder) will be placed near, perhaps under, the detector. The isobutane gas will be pumped out of the detector every half hour or so and replaced with fresh gas. The total amount of gas involved is extremely small. The detector will contain less than 1 mg of isobutane. By keeping the gas lines reasonably short the amount of gas in the lines can be kept to
2 mg. The total amount of isobutane vented into the experimental area will be no more than 6 mg per hour. The isobutane lecture bottle that will supply the gas holds

only
6 oz of isobutane when it is full.

2.4 SCHEDULE

We would like 6 hrs of one spill/minute beam to look at signals on the scope and make suitable adjustments to electronics and the data-taking program. If something needs to be rebuilt we will want to go away and come back another day. When everything is working properly, four hours of beam will provide ample data.

III. RESPONSIBILITIES BY INSTITUTION - NON FERMILAB

3.1 The detector, electronics, and gas supply will be brought from the U of Iowa.

IV. RESPONSIBILITIES BY INSTITUTION - FERMILAB

4.1 Fermilab Accelerator Division:

4.1.1 Use of MTest beam.
4.1.2 Maintenance of all existing standard beam line elements (SWICs, loss monitors, etc) instrumentation, controls, clock distribution, and power supplies.
4.1.3 Reasonable access to our equipment in the test beam.
4.1.4 The test beam energy and beam line elements will be under the control of the BD Operations Department Main Control Room (MCR).
4.1.5 Position and focus of the beam on the experimental devices under test will be under control of MCR. Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage.
4.1.6 The integrated effect of running this and other SY120 beams will not reduce the antiproton stacking rate by more than 5% globally, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning.
4.1.S Summary of Beam Division costs:

Type of Funds	Equipment	Operating	Personnel (person-weeks)
Total new items	$0.0K	$0K	0.0

4.2 Fermilab Particle Physics Division

4.2.1 The test-beam efforts in this MOU will make use of the Meson Test Beam Facility. Requirements for the beam and user facilities are given in Section 2. The Fermilab Particle Physics Division will be responsible for coordinating overall activities in the MTest beam-line, including use of the user beam-line controls, readout of the beam-line detectors, and MTest gateway computer.
4.2.2 We require one NIM bin and one CAMAC crate for the experiment.
4.2.3 We will need assistance in developing a beam trigger scintillator.

4.2.S Summary of Particle Physics Division costs:

Type of Funds	Equipment	Operating	Personnel (person-weeks)
Total new items	$0K	$0K	.2

4.3 Fermilab Computing Division

4.3.1 U of Iowa will supply all computer equipment.

4.4 Fermilab ES&H Section

4.4.1 We will require assistance with safety reviews.

V. SUMMARY OF COSTS

Source of Funds [$K]	**Equipment**	**Operating**	**Personnel** (person-weeks)
Beams Division	$0K	$0K	0
Particle Physics Division	0	0	0.2
Computing Division	0	0	0
Totals Fermilab	$0K	0	0.2

VI. SPECIAL CONSIDERATIONS

6.1 The responsibilities of the spokesman of the PPAC group and the procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Experimenters" (PFX). The Physicist in charge agrees to those responsibilities and to follow the described procedures.

6.2 To carry out the experiment a number of Environmental, Safety and Health (ES&H) reviews are necessary. This includes creating a Partial Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee. The spokesman of the PPAC group will follow those procedures in a timely manner, as well as any other requirements put forth by the division's safety officer.

6.3 The spokesman of the PPAC group will ensure that at least one person is present at the Meson Test Beam Facility whenever beam is delivered and that this person is knowledgeable about the experiment's hazards.

6.4 All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ES&H section.

6.5 All items in the Fermilab Policy on Computing will be followed by the experimenters.

6.6 The spokesman of the PPAC group will undertake to ensure that no PREP or computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Computing Division management. They also undertake to ensure that no modifications of PREP equipment take place without the knowledge and consent of the Computing Division management.

6.7 The PPAC group will be responsible for maintaining and repairing both the electronics and the computing hardware supplied by them for the experiment. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

6.8 At the completion of the experiment:

6.8.1 The spokesman of the PPAC group is responsible for the return of all PREP equipment, computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the spokesman of the PPAC group will be required to furnish, in writing, an explanation for any non-return.

6.8.2 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ES&H requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters.

6.8.3 The experimenters will assist the Fermilab Divisions and Sections with the disposition of any articles left in the offices they occupied, including computer printout and magnetic tapes.

6.8.4 An experimenter will report on the test beam effort at a Fermilab All Experimenters Meeting.

SIGNATURES:

________________________________ / / 2004
Edwin Norbeck, University of Iowa

______________________________________ / / 2004
John Cooper, Particle Physics Division

______________________________________ / / 2004
Roger Dixon, Accelerator Division

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Robert Tschirhart, Computing Division

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William Griffing, ES&H Section

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Hugh Montgomery, Associate Director, Fermilab

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Steven Holmes, Associate Director, Fermilab

APPENDIX I – U OF IOWA PPAC TEST **– EQUIPMENT POOL NEEDS**

Equipment Pool items needed for Fermilab test beam, needed on the first day of setup:

Quantity	Description
1	NIM crate, with cooling fans
1	CAMAC crate and power supply
2	Scintillators to locate the beam

APPENDIX II - Hazard Identification Checklist

Items for which there is anticipated need have been checked

	Cryogenics		Electrical Equipment		Hazardous/Toxic Materials
	Beam line magnets		Cryo/Electrical devices		List hazardous/toxic materials planned for use in a beam line or experimental enclosure:
	Analysis magnets		capacitor banks		
	Target	X	high voltage (1000V at 1.0□A max)		
	Bubble chamber		exposed equipment over 50 V		
Pressure Vessels		**Flammable Gases or Liquids**			
	inside diameter	Type:	Isobutane		
	operating pressure	Flow rate:	No continuous flow		
	window material	Capacity:	6 oz total		
	window thickness	**Radioactive Sources**			
Vacuum Vessels			permanent installation	**Target Materials**	
5 inches 4 mm thick	inside diameter		temporary use		Beryllium (Be)
30 torr	operating pressure	Type:			Lithium (Li)
Stainless steel	window material	Strength:			Mercury (Hg)
3/8 inches	window thickness	**Hazardous Chemicals**			Lead (Pb)
Lasers			Cyanide plating materials		Tungsten (W)
	Permanent installation		Scintillation Oil		Uranium (U)
	Temporary installation		PCBs	X	Other : **Iron (Fe)**
	Calibration		Methane	**Mechanical Structures**	
	Alignment		TMAE		Lifting devices
type:			TEA		Motion controllers
Wattage:			photographic developers		scaffolding/elevated platforms
class:			Other: Activated Water?		Others